Abstract

The TNO vision on competence development of architects is described. Architect, Architecture, and Architecting are placed in perspective. A didactic model of the layers attitude, ability, skills, and knowledge is the framework for the vision on education.
TNO-ESI evolved the competence development program for architects over many years.

Joris van den Aker is program manager and driver behind the program.
Our Primary Interest

developing organization

architect

system of interest
Context, Zoom-out and Zoom-in

customer organization

developing organization

architect

supplier organization

super system

system of interest

subsystems

Competence Development Program; Vision on Architecting and Education

version: 0
November 3, 2014
SEMABsuperSubEntities

Gerrit Muller
Adding the Time Dimension

past  current  future

customer organization

developing organization

architect

supplier organization

past super system  super system  future super system

past system of interest  system of interest  future system of interest

knowledge  innovation

past subsystems  subsystems  future subsystems

based on TRIZ
Architect, Architecture, Architecting

The diagram illustrates the process of architecting a system of interest. It shows the involvement of past, current, and future systems and subsystems. The architecting process is based on TRIZ (Theory of Inventive Problem Solving) knowledge innovation. It involves developing an organization's super system, which is future-oriented and based on past experience.
Challenges

past  current  future

- customer organization
- architect
- legacy constraints

heterogeneity

ambiguity

size & complexity

system of interest

unknowns

uncertainties

knowledge

innovation

based on TRIZ

past subsystems

future subsystems

version: 0
November 3, 2014
SEMABchallenges
From Theory to Practice

Theory: typical SE workflow: V-model, requirements management, “top-down”

- **verification** of result against specification
- **specification**
- **system design**
- **subsystem design**
- **component design**
- **component realization**
- **component test**
- **subsystem test**
- **system test**
- **verification**
- **validation**

**requirements**
- specification as input to the design, documented
- **SMART**
  - Specific, Measurable, Acceptable, Realistic, Traceable

**requirements engineering**
- the flow down of the requirements through the V.

Practice: Finite knowledge and wisdom causes late disruptions

- size & complexity
- heterogeneity
- ambiguity
- unknowns
- uncertainties
- legacy constraints

Innovation and new territory require *learning*, e.g.
- *experimenting*, exploring,
- *failing*, *discovering*
complement with “bottom-up”
Waterfall model

- identify needs
- specify
- design
- realize
- integrate
- verify & validate

**works well:**
- in mature product-market combinations
- with long development cycles

**works poorly:**
- in new product-market combinations
- short development cycles
Concurrent Engineering

identify needs

specify

design

realize

integrate

verify & validate

- total development time is shorter
- technology constraints & opportunities take time to get in the picture
- validation is still late (=feedback on uncertain requirements)
Iterative Approach

- identify needs
- specify
- design
- realize
- integrate
- verify & validate

learn fast by iterating over needs and technology
- more chaotic
- requires agile mindset

Competence Development Program; Vision on Architecting and Education

version: 0
November 3, 2014
BSEARIterativeApproach
Architect and Typical Expectation from Organization

- **characteristics**
  - prime interest of customer
  - results in
  - functionality
- **dynamics**
  - interact
  - prime interest of organization
- **parts**
Final Delivery: T-shape Presentation to Top Management

- **societal trends**
- **opportunities**
- **problems**
- **needs**

- **business/market competition**
- **trends**
- **opportunities**
- **problems**
- **needs**

- **customers stakeholders**
- **key drivers**
- **concerns**
- **applications**

- **product project system**
- **functions**
- **key performance**

- **design and concepts**
- **functional, physical quantified**

- **specific aspects**
- **functional, physical quantified**

- **technology**
- **critical or new**

- **business quantification risk analysis**

- **summary how solution answers needs**

- **why choices are appropriate**

- **conclusions and recommendations**

---

Competence Development Program; Vision on Architecting and Education

version: 0
November 3, 2014

SEMApresentationTshape

Gerrit Muller
Competence Development: working at multiple levels

- **what**
  - attitude
  - ability
  - skills
  - knowledge

- **how**
  - lecturing
  - exercises
  - assignments
  - practice
  - coaching
  - reflection

- **who**
  - participant
  - teacher/coach
Architecting: Fit-For-Purpose

**market and customer context**

**life cycle context**

**system architecting**

multi-disciplinary design

**mono-disciplinary engineering**

- software engineering
- electrical engineering
- mechanical engineering

understand context
analyse needs
specify system
explore design options
validate & verify

design, engineer, build, test

Competence Development Program; Vision on Architecting and Education

Gerrit Muller

version: 0
November 3, 2014
BSEARarchitecting
Delivery at the end of this module

- value proposition
- business proposition
- system specification
- design

system architecting
multi-disciplinary design
electrical engineering
software engineering
mechanical engineering

market and customer context
Alternate Knowledge/Skills and Attitude

- attitude
- ownership development
- take stakeholder’s viewpoint
- be critical and sharp
- embrace uncertainty

- ability
- role architect
- framework
- modeling

- skills
- knowledge
- development
- viewpoint
- ownership
- framework
- modeling